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SOME ASPECTS OF MEMORY IN THE INSANE ¹

By FLORENCE BERENICE BARNES

Report of Experiments Performed in the Psychopathic Ward of the
University of Michigan

The object of the experiments was to repeat on the insane certain of the experiments that have been used with normal individuals in the endeavor to understand in more detail the changes of memory in insanity. Our particular problem was to determine the rate of learning and degree of retention as compared with the normal and to study the relative value of 'heaped up' vs. divided repetitions and the influence of generative, effectual and retroactive (Rückwirkende) inhibition.

In the experiment the learning method and the Treffer method were used in approximately the pure form.² In the learning method, it will be remembered, impression is measured by the number of repetitions needed for the first perfect repetition, and the degree of retention by the number of additional repetitions required after the lapse of a given time to bring the series back to one perfect repetition. In the Treffer method impression is measured in the same way, but retention is tested by the number of cases in which the second syllable in a pair can be supplied when the first is suggested. Ordinarily the syllables are given successively and paired by accenting every other syllable. In addition in our work the syllables were paired by writing two syllables side by side on the cards. In the experiments by both methods both the one column and two column cards were used. The one is referred to in the text as the learning or reading syllables in single order, the other as learning or reading in double order.

It may be interesting to note that it is much more difficult to make out lists of nonsense syllables in English than in German, for the English language has a large number of words of three letters while the German has comparatively few. The number of nonsense syllables left after striking out those that make sense from the combinations of letters is correspondingly small. Our diphthongs, too, are less numerous than the German diphthongs and umlauts, and diphthongs in our experiments were found to confuse the subjects to a very marked degree.

¹ Communicated by W. B. Pillsbury.

Ebbinghaus: Grundzüge d. Psychologie, 2 Aufl. p. 646 ff.

It was found possible to perform the whole series of experiments with but two subjects, patients suffering from syphilis of the brain with mental disturbances. These patients were subject to convulsions every few weeks and would have no memory after the attack of what had occurred to them during the attack. In fact, they knew that they had been ill only by the feeling of dizziness and weakness, and the general soreness that resulted from the convulsions. Both subjects were easily fatigued, and after a very short time of testing would complain of dizziness and the complete vanishing of the impressions from mind when the card was removed. In addition to these two patients a number of others were used for one or more problems. A number of forms of mental disease were represented in the different experiments. The others could not be counted on regularly, however, as they are often incapable of learning a series completely, no matter how great the number of repetitions, and in the circular cases there would frequently be days when the patient would be incapable of working. The tables will indicate the forms of insanity to which the patients were subject.

Certain general difficulties in the conduct of experiments upon the insane may be noted in advance in connection with the departure from the ordinary course of procedure that they necessitate. The conditions of the subjects vary not merely from day to day, owing to the stage of excitement or depression in which the subject is found, but they vary from moment to moment. Nearly all cases are very much given to introspection. They are constantly thinking of their own condition and one can never say when the learning will be interrupted by some impelling thought of themselves. This may be suggested by the syllables, or by some chance incident, internal or external. Coupled with this attention is easily distracted, and will seldom be given long to one subject or task. It was this that compelled the use of the *Treffer* method. For in the method of learning repeated mind wanderings might prevent the learning entirely, a series might never be repeated a sufficient number of times, without distraction, to permit it to be learned, and so no test would be possible, while it would be possible to get a sufficient number of repetitions to forge some links, and these could be tested at favorable moments. By the *Treffer* method the strength of each link of the chain may be tested, while in the learning method the strength of the chain as a whole alone can be taken into account, and the strength of the chain is the strength of the weakest link.

This consideration, too, dictated making the apparatus as simple as possible, so that all elaborate exposure or recording apparatus was done away with and the syllables printed upon

a card and all exposed at once by passing the card to the patient with the request to commit to memory. This method of course brought in disturbing inhibitions but it obviated the necessity of teaching the patient to shuffle the cards at regular intervals, and insured that none should be omitted, through the patient's clumsiness of manipulation.

The first two part problems that we have dealt with are the influence of the different repetitions, and of the number of syllables in a series upon the formation of association. Ebbinghaus¹ found for normal individuals that the repetitions were all of equal value. In the insane this is not at all the case. The first repetition is of much greater value than any of the others. The next eleven repetitions hardly double the number of right responses by the Treffer method. The explanation is to be found in fatigue and wandering attention. In this connection it may be remarked that in the insane much more even than in the normal, failure to learn is due to failure to attend. The number of repetitions is much less important than the character of the repetitions. Attention affects both the strength of the associations and the strength of the perseverance tendency, and upon these two factors alone depends the liability to recall.

As far as fatigue does not enter, we might suppose that the same number of repetitions of a series of syllables would bring the same strength of syllable associations, no matter how long the series is. But many accidental influences may enter to add to or detract from certain associations, and the longer the series is, the more chance they have to act. The same number of readings of a series fatigues according to the length of the series. This results in paying less attention to the last readings than to the first. The longer the series, the more numerous the syllables in readiness to rise to consciousness, and so the number of inhibitions proceeding from them is greater, and a greater number of readings is necessary to learn them.

The first and the last syllables of a series make a stronger impression than those intervening, though sometimes the first syllable, instead of calling more forcible attention to itself simply draws forth attention which is directed on to the second and following. The degree of stress also strengthens the syllable by setting up certain kinæsthetic associations of the tongue and palate.

In Table 1 is given the number of repetitions necessary to learn series containing different numbers of syllables from six to twelve. It will be recalled that with normal individuals six to eight syllables can be learned at one repetition, twelve in fourteen to sixteen repetitions. The disparity against the in-

¹Ebbinghaus: Ueber das Gedächtniss, § 19.

sane is increased by the fact that not more than twelve repetitions could be made on the same day without unduly fatiguing the patient, and this must of course be rigorously avoided. In accordance with Jost's law this should greatly reduce the number of repetitions required.²

TABLE I

Subjects.	Syllables.	Repetitions.	Subjects.	Syllables.	Repetitions
F—	6	14	S—	6	Infinite.
	8	25	Manic	8	"
Cerebral	10	41	Depressive	10	"
Syphilis	12	49	Excitem't	12	"
B—	6	12	S—Manic	6	"
	8	16	Depressive	8	"
Cerebral	10	37	Depres'ion	10	"
Syphilis	12	48		12	"
R—	6	8	R—	6	3
Paranoid	8	13	Maniacal	8	7
Dementia	10	17	Excitem't	10	11
	12	33	Nearly	12	14
			Recovered		
L—	6	12	S—	6	2
Senile	8	17	Dementia	8	5
Dementia	10	too fatig'ing	Praecox	10	9
	12	" "		12	12

Note that the manic-depressives were unable to make any progress whatever in correctly recalling their series. This was due almost entirely to default of fixation, as before stated. The case of dementia præcox shows little defect of memory.

In the case of brain syphilis, perhaps, a few quotations from the patients' own remarks may serve to clear up these results more than any technical explanation.

"When I try so hard to retain them it increases the pain in my back and it shoots up into my head and makes me dizzy, and when I don't try hard to retain them they all leave me. Sometimes they go so I can't think or get them back at all, and sometimes I imagine I can see them and spell them. When I get lots of words, I get the words on different cards mixed up. Other ideas seldom enter—at least not so much now as they did." [Yet at the slightest interval of rest, patient will begin to talk of her home, her family, her condition, etc.] "The chief interruption has been the pain spells. With the dizziness, the syllables seem to vanish from mind. I think

²Jost: Zeitschr. f. Psych. u. Phys. d. Sinnesorg. XIV, p. 436.

of the syllables between times. In the morning when I wake up, I think of the words on the cards and try to repeat them all. I sometimes dream of them. The syllables seem to drop away suddenly and leave an absolute blank."

INHIBITIONS

There are a number of factors in the nature of the test itself, which hinder or inhibit the rise of the right response to consciousness, or tend to put another in its place. Two kinds of inhibitions noted by Müller and Pilzecker¹ are the generative and the effectual. Syllables already associated with other syllables are with difficulty associated with new ones. This is called generative inhibition. Effectual inhibition is caused by the mutual interference of the tendencies to reproduce each of two syllables which are associated with the one given. These two inhibitions commonly work together and are really two sides of one and the same process.

The test for noting the number and form of these inhibitions was given in the following manner. Two lists of syllables were made out thus:

$$\begin{array}{l} 1) \ v_1 \ u \mid h_1 \ u \mid v_2 \ u \mid h_2 \ u \mid \\ 2) \ v_3 \ u \mid h_2 \ u \mid v_4 \ u \mid h_1 \ u \mid \end{array}$$

Let v_1, v_2, v_3, v_4 , represent different syllables; h_1, h_2 are respectively the same for each list; u differs in each case.

For instance,

$$\begin{array}{ll} (v_1) \text{ poli} - (u) \text{ sil} & (v_3) \text{ mag} - (u) \text{ rit} \\ (h_1) \text{ tim} - (u) \text{ laim} & (h_2) \text{ lis} - (u) \text{ wef} \\ (v_2) \text{ cholg} - (u) \text{ bol} & (v_4) \text{ paon} - (u) \text{ loip} \\ (h_2) \text{ lis} - (u) \text{ fey} & (h_1) \text{ tim} - (u) \text{ neap} \end{array}$$

The two lists were written consecutively on the same card, as given, so that in reading the total number, h_1 and h_2 , would be read in connection with two separate syllables each, and the two associations thus set up would be mutually inhibitive.

We will call h_1 and h_2 the chief syllables, since it is most largely with them that we have to do at present, and v_1, v_2, v_3, v_4 the stimuli, and u , in its various forms, the response.

It may be noted that in reading the second part of the list, the chief syllables already met in the first part, have become more or less familiar through this fact, and so tend to draw special attention to themselves, thus lessening the inhibition. Reading the chief syllables of the second part may also recall the syllables associated with them in the first part, and thus strengthen the associations. When both the associations are

¹ Müller und Pilzecker: *Exper. Beitr. zur Lehre vom Gedächtniss*, *Zeitschr. f. Psych., Ergänzungsband I*, pp. 144-168.

given in response to the chief syllable stimulus, we call it a double case. These double cases are of two kinds, according to whether the response of the first part or the response of the second part is given.

The lists are read in the same order at each sitting, but the stimuli are given in a different order each time, that they may be mixed up as much as possible, thus avoiding the elimination of inhibition by rote learning, due for the most part to a sense of the absolute position of the syllable in the series.

A little further explanation of the character of these inhibitions may help to an understanding of the results.

If a syllable h_1 already associated with u , is read in the new combination $h_1 u_1$ in general a re-arousal of the association $h_1 u$ takes place, in that through the reading of h_1 the syllable u is placed in readiness, or in case the arousal is more intense, even brought into consciousness. This also has the effect, that the association $h_1 u$, through this re-arousal, gains in strength, or that at least an easier and quicker reproducibility exists for the next time. The intensity of the associative re-arousal depends on the strength which the association $h_1 u$ possesses at the time of giving the combination $h_1 u_1$. This is dependent on the amount of attention given to the combination $h_1 u$ when it entered consciousness, on the number of repetitions which it received, and on the length of time which separated the reading of the combination $h_1 u_1$ from that of the combination $h_1 u$. If by reading the combination $h_1 u_1$ the earlier formed association $h_1 u$ is aroused, this associative re-arousal has not merely an intensifying effect for the association $h_1 u$ or at least the reproducibility of u , but it acts at the same time as an inhibition for the forming of the association $h_1 u_1$. This generative inhibition not only takes place when in the reading of the combination $h_1 u_1$ the syllable u always comes into consciousness after the appearance of h_1 but also when at the appearance of h_1 the syllable u is placed in readiness, and in reality only a recognition of h_1 takes place. The more intense the re-arousal of the combination $h_1 u$ by the reading of the combination $h_1 u_1$ the stronger is the generative inhibition for the association $h_1 u$. These inhibitions may not take place in cases of flights of association, since the combination $h_1 u$ may not be strongly enough associated to inhibit the association of $h_1 u_1$, but in these cases the latter association, weakened by the same cause, is not strong enough to be recalled when the stimulus is given. As a rule, an impulse from a nerve centre along two courses will take the course which has been most frequently travelled, but if obstructed in any way on this course, will turn all the more strongly into the new path. Results of these two forms of inhibition are given in Table II.

TABLE II

Subjects.	Number of Tests.	No. of Inhibitions.	Double Cases.
B— Cerebral Syphilis	8 (1st series in dif. orders.)	6	2
	8 (2nd series in dif. orders.)	4	4
	8 (3rd series in dif. orders.)	5	3
		<u>5</u>	<u>3</u>
	Total	15	9
F— Cerebral Syphilis	8 (1st series in dif. orders.)	7	1
	8 (2nd series in dif. orders.)	5	3
	8 (3rd series in dif. orders.)	5	3
		<u>5</u>	<u>3</u>
	Total	17	7

In the manic depressives it was impossible to obtain results in these tests. During excitement the number of random associative combinations with syllables of the series being given, or with some other was so great that the strength, or even the existence of inhibitions could in no way be accurately determined, while in depression one cannot tell whether the customary unresponsive attitude of the patient to the stimuli is due to specific inhibition of any particular association or to the general associative retardation peculiar to this state.

These tests were rather too difficult to be applied to the patients afflicted with other forms of insanity mentioned in the results of the simple repetition tests.

From the results given in the tests of the two cases of cerebral syphilis, we see that although a supposed disintegration of the centres has here taken place, thus increasing the difficulty of forming associations, yet when once formed they may have an inhibitive influence on the formation of new ones. It is to be noted, however, that the inhibitions in these cases were for the most part negative rather than positive, that is, it would most often be found impossible to give any response to the stimuli with double combinations, rather than that the syllable combined with one should be given as a response to the other. This shows that the inhibition in these cases is due, not so much to the influence of a definitely formed previous association as to a generally confused and retarded mental state incident to the disease.

Closely related to these inhibitions is the "rückwirkende" or

retroactive inhibition.¹ In the reading of a syllable series certain physiological processes, which serve to strengthen the associations set up by the reading of the series, last a certain time, with gradually decreasing strength. These processes, and their beneficial influences on the associations are more or less weakened, if the person experiences an interval of mental activity immediately after the reading of the series. This mental activity, creating new associations, tends to weaken the old ones,—thus inhibiting their retention and recall,—just as established old ones hinder the formation of the new.

This inhibition is naturally stronger, the greater the attention given to the following mental activity, and the earlier it takes place, so that a period of rest between the readings is advisable if this is to be eliminated. (See discussion of Jost's Law.) Not only mental activity in the form of work results in this inhibiting tendency, but every strong distraction of the attention immediately after the impression of an idea injures its retention. Impressions should have time to *set* or *consolidate*. This is especially important in testing pathological cases, since frequently, though the series is read with seemingly good attention, immediately after reading the subject may be attracted toward or remark about something in the room, or pertaining to his own condition or affairs.

The retroactive inhibition was found to have much greater influence in cases of associative incapacity than in the normal, because the previously formed associations have so little strength that any different activity immediately following their presentation becomes a serious obstacle in the way of their retention. The tests for observing this inhibition particularly were made in three ways: 1, the subject was required to read a series of syllables of the same length as the presentation series, immediately after the reading of the latter. He was then required to recall as many as possible of the presentation series; 2, a piece of poetry or a short newspaper article was read to the subject after he had finished reading the presentation series; 3, the subject was engaged in conversation for a few minutes after reading the series, without his knowing that it was done for a purpose. For instance, his attention would be drawn to something outside the window, or an interesting bit of news would be told him, or rather her, for the subjects were women.

The stimuli consisted of a simple series of eight syllables, and it was found necessary in all cases to have ten repeated readings with two minute rests between, before the interval of different mental activity following, since it will be seen by reference to Table I, that about twenty repetitions are required to learn an

¹ Müller und Pilzecker: *op. cit.*, pp. 174-198.

eight syllable series perfectly. In the results, the number of false and negative responses divided by two will give approximately the number of cases due to the retroactive inhibition. It was impossible to give twenty readings during a single test, as the element of fatigue, and resultant inattention would have destroyed the value of the results.

TABLE III

1. *Reading of dif. series after presentation. (10 series.)*

Subject.	No. Syls. Read.	Correct Recall.	False Cases.	Negative Cases.
F— Cerebral Syphilis	80	14	43	25
	Av. 8	1.4	4.3	2.5

$6.8 \div 2 = 3.4$ or 42% of responses influenced by inhibition. (10 series.)

Subject.	No. Syls. Read.	Correct Recall.	False Cases.	Negative Cases.
B— Cerebral Syphilis	80	17	49	14
	Av. 8	1.7	4.9	1.4

$6.3 \div 2 = 3.15$ or 39.3% of responses influenced by inhibition.

The large number of "false" cases in these results is due for the most part to associative combination of the syllables of the presentation series with those of the inhibitive series. The existence of this combination is none the less an inhibition to correct recall.

TABLE IV

2. *Reading matter after presentation. (10 series.)*

Subject.	No. Syls. Read.	Correct Recall.	False Cases.	Negative Cases.
F— Cerebral Syphilis	80	20	17	43
	Av. 8	2	1.7	4.3

$6 \div 2 = 3$ or 37.5% of responses influenced by inhibition. (10 series.)

Subject.	No. Syls. Read.	Correct Recall.	False Cases.	Negative Cases.
B— Cerebral Syphilis	80	25	22	33
	Av. 8	2.5	2.2	3.3

$5.5 \div 2 = 2.75$ or 34.4% of responses influenced by inhibition.

Notice the smaller number of false cases here, as compared with negative ones, as there is little chance for associative combination outside of the presentation series.

TABLE V

3. *Conversation after presentation.* (10 series.)

Subject.	No. Sylls. Read.	Correct Recall.	False Cases.	Negative Cases.
F— Cerebral Syphilis	80	19	29	32
	Av. 8	1.9	2.9	3.2

$6.1 \div 2 = 3.05$ or 38.1% of responses influenced by inhibition.
(10 series.)

Subject	No. Sylls. Read.	Correct Recall.	False Cases.	Negative Cases.
B— Cerebral Syphilis	80	27	13	40
	Av. 8	2.7	1.3	4

$5.3 \div 2 = 2.65$ or 33.1% of responses influenced by inhibition.

If the results are closely examined, it will be seen that the inhibitive value is slightly greater than can be accurately determined, for the following reason. We have seen that an average of about twenty repetitions was necessary in these two cases to learn a given eight syllable series correctly. (See Table I.) We have also seen that the value of the individual repetitions decreases with their number. Therefore the first ten repetitions should give more than half correct results, merely because of the number of repetitions, so that the number of false or negative cases due to lack of repetition must be slightly less than half the total number, and those due to inhibition a little more than half, so that, on the whole, we may say that about forty per cent. of the responses in this test were influenced by retroactive inhibition from the various forms of mental activity following the readings of the presentation series.

ASSOCIATIVE COMBINATIONS

Probably the most fertile source of false cases is the tendency to combine elements of one association with those of another. There are two reproduction tendencies, one including the beginning and ending consonants, the other the vowels, and the most frequent combination is giving the consonants of one syllable and the vowels of another, viz.:—zet—kap—kep.

The response may be 1. a combination of the right syllable with the given stimulus; 2. a combination of the right syllable with a syllable following or preceding it in the series; 3. a combination of the right syllable with the syllable occupying the same absolute position in another series; 4. a combination of the right syllable with the syllable with which the stimulus is connected by association with a preceding or following syllable; 5. combination of right syllable with a once given false response to a given stimulus, or a similar syllable; 6. combination of right syllable with similarly stressed syllable in preceding group; 7. combination of right syllable with syllable of related series spelled backward; 8. combination with some word or sound of daily life not entering into the experiment.

To determine the number and character of associative combinations in the pathological cases under investigation, a test was given consisting of ten different series of eight syllables each; five of the series were simple lists, where the subject was required to recall as many as possible; and five were the double lists, where, after reading the series a certain number of times, the subject was required to state the syllable immediately following the chief syllable given as stimulus. With the exception of a case of maniacal excitement, the tendency to combination was greater in case of the former than of the latter, probably because in the latter each association is reinforced in a definite way by giving as stimulus the syllable directly combined with it in the reading. It is obviously extremely hard to classify each combination according to the eight divisions given above. It will suffice to say that one or more were found under each division, —enough to justify the classification which I have given. In the results, only those cases are noted in which the incorrectness was found to be really, or at least very presumably, due to associative combination. Each series was read ten times, both for the double and the single lists.

TABLE VI
Single Lists

Subjects.	No. of Syls.	False Cases.	Assoc. Combinations.
F—Cerebral Syphilis	40	25	19
B— “ “	40	20	19
S—Maniacal Excitement	40	36	27

The correct and the negative responses are not listed, as they are of no value in this test. Note the great number of associative combinations in the case of maniacal excitement. These

belonged for the most part under classification 8, being often due to combinations with biblical names and references, having similar sounds. In the other two cases the combinations were for the most part traceable to classifications 3, 4 and 6, showing greater concentration of attention, inasmuch as the associations do not tend to wander outside of the work in hand.

TABLE VII
Double Lists

Subjects.	No. of Syls.	False Cases.	Assoc. Combinations.
F—Cerebral Syphilis	40	22	14
B— “ “	40	19	12
S—Maniacal Excitement	40	36	29

In the last case a large percentage of the combinations were due to the sound of the stimulus given,—the tendency was to introduce the vowel of the stimulus between the consonants of the response. The person troubled with flight of association is easily influenced by similarity of sounds of words. This is perhaps seen more plainly in simple association tests, when he is required to tell what he thinks of when certain words are given as stimuli. In a large number of cases he will give a word rhyming with the one given or add a syllable to it to make a longer word. The percentage of false cases which are found to be associative combinations is little greater in case of the abnormal than of the normal. Of course the percentage of false cases is itself much greater than in the normal, so that the tendency to associative combination is also seen to be much greater, but in both normal and abnormal cases, false responses are largely due to this tendency to combine associations.

OTHER CAUSES OF FALSE CASES

A response is often given which is not a combination of the correct response with some other syllable,—but which has no elements of connection with it. This incorrect response may be due to one or more of several reproduction tendencies. The stressed beginning syllable of a group is connected with the unstressed end-syllable of the preceding group by an association of noticeable strength. Carrying this further, we may say that any syllable has a greater or less tendency to recall any preceding syllable of the series, according to the degree of stress of the syllable given, or those preceding. The same rule holds for the connection of a given syllable with those following it

in the series. This takes place through mediating associations of the intervening syllables.

Substitution is another important factor in false cases. For instance, if an idea *a* tends to reproduce idea *b*, an idea similar to *a* will also tend to reproduce *b*. This is active substitution. Passive substitution is the reproduction of an idea similar to *b*, on giving the stimulus *a*. Thus a syllable *a* may show a tendency to reproduce a syllable *c* which neither mediately nor immediately follows *a*, but only possesses the peculiarity of being associated with a syllable *b* which is itself associated with *a*.

Further causes of false cases, having close connection with the reproduction tendencies just mentioned, are the following :

1. Syllables given a week or a month before are recalled instead of the right one
2. When a given stimulus does not reproduce the right syllable it still brings it to the threshold of consciousness, so that it comes suddenly into consciousness and is named when the next syllable is shown.
3. In a few cases the response to a given stimulus is a stimulus that has already been given.
4. The given syllable may be one that will, together with the shown syllable, give the sound of a familiar word, viz., *bur—dok*.
5. Syllables similar in meaning to the proper one are sometimes given.

It may here be noted that ease of learning is increased in both abnormal and normal cases.

1. If two or more successive syllables have the same initial consonant.
2. If two successive syllables form a rhyme.
3. If two successive syllables contain the same vowel or diphthong.
4. If the final consonant of a syllable is the same as the initial consonant of the syllable immediately following.
5. If two or more syllables form a word or phrase, or if the syllable is itself a word.
6. Unusual combinations and those especially difficult to pronounce, are a hindrance to learning.
7. Rhythm is favorable.

DIFFERENCE OF DISTRIBUTION (JOST'S LAW)

A period of rest of greater or less length between the repetitions of the syllable series has an important and favorable influence on their recall.

According to Jost, "Of two associations of the same strength but different age, the more recent disappears quicker than

the older,"¹—so that the number of right cases is inclined to be less when the recall takes place immediately after the reading, than when a period of rest ensues, giving the impressions time to *set*, as it were. Jost found that the associations which were obtained by a constant number of repetitions of a syllable series possessed greater strength twenty-four hours after the last repetition, if the repetitions were distributed over several days, with intervals of twenty-four hours.

Jost also shows that the proved advantage of the distribution with long intervals cannot be wholly explained through the fatigue which is experienced from a greater number of repetitions immediately following each other, and as an explanation he formulates the important law that when associations are of like strength but different age, a new repetition possesses a greater strengthening power for the old association than for the new, or, in other words, associations of the same reproducibility disappear more slowly the older they are and the more frequently they are strengthened by new impressions.

It is a significant fact that the results show the influence of distributed repetitions to be markedly favorable in pathological cases, much more so than in the normal. This is due to the fact that the mentally defective subject is unable to keep his attention on the constantly repeated series until the time of recall, while the series whose repetitions are distributed over several days is met with fresh attention each day, and is reinforced in the interval by involuntary recall.

This test was conducted with the double series, each consisting of ten double, or twenty single syllables. One such list was repeated once a day for ten consecutive days. The other was repeated ten times daily until perfect recall was possible. Only one complete test could be made, owing to the difficulty of being able to arrange ten consecutive days on which the subjects were not kept from the experiments by their physical condition, as every care was taken that this work should not interfere in any way with the treatment and improvement of the patients. Owing to this many results had to be thrown out, because more than the twenty-four hours would intervene between experiments.

TABLE VIII

Subjects.	No. distrib. reps. nec. for correct recall.	No. consecutive reps. nec. for correct recall.
F—(Cerebral Syphilis)	10	40
B—	10	40

¹ Jost: *op cit.*, p. 459.

As in all the tests, only ten consecutive readings were allowed daily, so that the results under this heading are diminished by the three twenty-four hour intervals necessary to forty repetitions.

One would conclude from the results of this test that persons with defective memories would find it very beneficial when memorizing, to distribute the repetition over as great a length of time as possible.

Some results were taken to show the advantage of connected over disconnected matter in facility of learning, and the advantage of learning as a whole over that of learning in parts, but they are not sufficiently numerous or definite to offer very important explanations.

In conclusion, I desire to thank Dr. A. M. Barrett, Director of the ward, for permission to use the patients, for access to the case records and numerous suggestions in the course of the experiments.

SUMMARY

1. Increasing the number of syllables in a series increases the number of repetitions required in the case of these insane patients much faster than in the case of the normal individual.

2. Generative, effectual and retroactive inhibition are much more pronounced in their effect in the abnormal than in the normal.

3. There is much greater advantage in divided over 'heaped up' repetitions for the insane than the sane.

4. All the sources of confusion and error work more markedly for the pathological mind than for the healthy.

In short all the factors investigated are operative in the diseased as in the well mind, and with much greater force.